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## Volume 7, No. 1, March 1998

# CRITICAL REVIEW OF THE STATUS OF ROAD SAFETY IN MALAYSIA


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### Introduction

Road safety has long been considered one of the social responsibilities of the Malaysian Government. Since the country's independence, a number of bodies concerned with road safety have been formed within government departments, private sector agencies and voluntary organisations. The concern for road safety was more visible, however, following a Karak Highway accident in 1990. The aftermath of the accident saw the government forming a Cabinet Committee on Road Safety, with the Prime Minister as the chairman. The committee set a target of reducing fatalities by 30% by the year 2000. In 1991, a comprehensive National Road Safety Plan was formulated with special attention on safety research programmes, behavioural modification of road users, road engineering and vehicle safety, medical treatment and safety administration.

This paper attempts a critical review of the status of road safety in the country with a special reference to the impact of road safety initiatives recently undertaken. It consists of three parts:

- a review of the present status of road safety;
- an evaluation of safety interventions recently carried out to meet the safety target; and
- a discussion of future strategies that can bring about further reduction in injury to meet the national safety target.

### Status of Road Accidents in Malaysia

Since gaining independence in 1957, Malaysia has been experiencing rapid growth in population, economy, industrialisation and motorisation. Between 1970 and 1994, the population doubled from 9,000,399 to 19,494,000, an average growth rate of about 5% per year. During the same period, the total length of roads increased threefold, from about 19,433 to 59,796 kilometres, forming a transport network in Peninsular and East Malaysia (Table 1).

The growth in traffic during the same period also experienced a similar trend. Over a span of 24 years, the population of registered vehicles increased from 669,292 in 1970 to 7,210,089 in 1994, a ninefold increase in just over two decades. Motor vehicle ownership increased accordingly from 13.4 people per vehicle in 1970 to 2.97 people per vehicle in 1992, a figure comparable to the rates observed in developed countries.

**Table 1 General Road Accident Statistics in Malaysia**

| Year | Population | Vehicles registered | Vehicles involved | Road length (km) | No. of accidents | Casualties | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Death | Serious | Slight | Total |
| 1970 | 9,000,399 | 669,294 | 19,433 | 10,715 | 12,704 | 579* | 1,421* | 5,621 | 7,621 |
| 1971 | 9,133,506 | 730,035 | 26,025 | 11,062 | 16,847 | 1,548* | 541* | 6,392 | 8,481 |
| 1972 | 9,873,623 | 802,831 | 34,944 | 11,062 | 22,151 | 1,712* | 631* | 8,373 | 10,716 |
| 1973 | 10,130,672 | 939,951 | 45,916 | 11,062 | 29,286 | 1,922* | 2,504* | 12,176 | 16,602 |
| 1974 | 10,434,592 | 1,090,279 | 39,056 | 11,161 | 24,581 | 2,303* | 744* | 10,285 | 13,332 |
| 1975 | 10,438,137 | 1,267,119 | 75,653 | 12,043 | 48,233 | 2,317 | 2,280 | 14,843 | 19,440 |
| 1976 | 10,472,544 | 1,429,845 | 80,995 | 12,340 | 48,291 | 2,405 | 2,585 | 14,337 | 19,327 |
| 1977 | 10,716,642 | 1,621,271 | 86,688 | 12,637 | 54,222 | 2,512 | 3,033 | 14,760 | 20,305 |
| 1978 | 10,944,500 | 1,829,958 | 91,122 | 13,399 | 56,021 | 2,561 | 3,883 | 15,215 | 21,659 |
| 1979 | 11,188,630 | 1,989,391 | 94,788 | 13,772 | 57,931 | 2,607 | 5,384 | 14,620 | 22,611 |
| 1980 | 11,442,086 | 2,357,386 | 99,485 | 14,446 | 59,084 | 2,568 | 5,097 | 14,739 | 22,404 |
| 1981 | 14,128,354 | 2,901,182 | 107,552 | 31,568 | 63,192 | 2,769 | 4,898 | 14,636 | 22,303 |
| 1982 | 14,506,589 | 3,246,790 | 126,474 | 36,238 | 74,096 | 3,266 | 4,871 | 14,683 | 22,820 |
| 1983 | 14,886,729 | 3,594,943 | 139,006 | 40,664 | 79,150 | 3,550 | 5,656 | 17,351 | 26,557 |
| 1984 | 15,437,683 | 3,941,036 | 140,012 | 42,254 | 80,526 | 3,637 | 5,532 | 16,383 | 25,552 |
| 1985 | 15,866,592 | 4,243,142 | 142,653 | 43,944 | 82,059 | 3,603 | 5,652 | 14,699 | 23,924 |
| 1986 | 16,278,001 | 4,458,735 | 137,175 | 44,100 | 79,804 | 3,525 | 5,442 | 14,290 | 23,257 |
| 1987 | 16,527,973 | 4,595,434 | 131,609 | 44,239 | 76,882 | 3,320 | 5,548 | 12,931 | 21,799 |
| 1988 | 16,921,300 | 4,783,506 | 124,922 | 44,428 | 73,250 | 3,335 | 5,548 | 13,655 | 22,538 |
| 1989 | 17,376,800 | 5,071,786 | 127,279 | 44,592 | 75,626 | 3,773 | 7,249 | 19,015 | 30,037 |
| 1990 | 17,812,000 | 5,462,792 | 146,747 | 50,835 | 87,999 | 4,048 | 8,076 | 17,690 | 29,814 |
| 1991 | 18,178,100 | 5,877,176 | 161,828 | 55,367 | 96,513 | 4,331 | 8,524 | 17,252 | 30,107 |
| 1992 | 18,606,000 | 6,263,383 | 193,421 | 59,796 | 118,554 | 4,557 | 10,634 | 21,071 | 36,262 |
| 1993 | 19,050,000 | 6,712,479 | 220,939 | 59,796** | 135,995 | 4,666 | 11,930 | 25,090 | 41,686 |
| 1994 | 19,494,000 | 7,210,089 | 251,686 | 59,796** | 148,801 | 5,159 | 13,387 | 29,957 | 48,503 |

Source: Royal Malaysia Police 1994

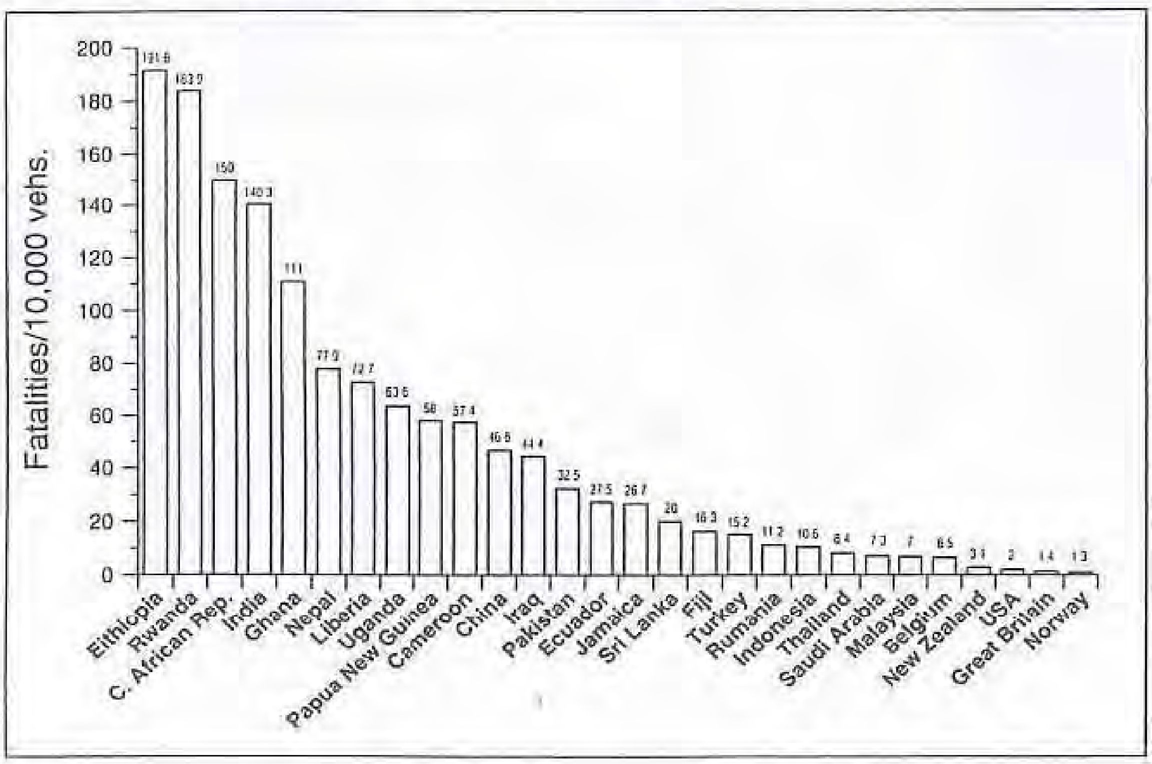
* These figures are regarded as not reliable **Based on 1992 figures

The increase in population and motorisation also led to an increase in the number of road traffic accidents. In 1970 (Table 1), the number was only 12,704 cases, based on manual counts issued by the Traffic Branch of the Royal Malaysia Police (PDRM, 1994). In 1994, this figure rose to a total of 148,801 cases, an increase of approximately 1,100% within just over two decades.

The number of fatalities (death within 30 days after an accident) also increased from 579 in 1970 to 5,159 in 1994. At an average growth rate, fatalities are forecast to rise from 4,048 in 1990 to 5,464 in the year 2000, an increase of about 35% over a 10-year period (Radin, 1994a). If a higher growth rate is considered, based on the increased growth rate in the boom period between 1985 and 1991, fatalities are expected to rise to 6,782 in the year 2000, an increase of 67% over a 10-year period.

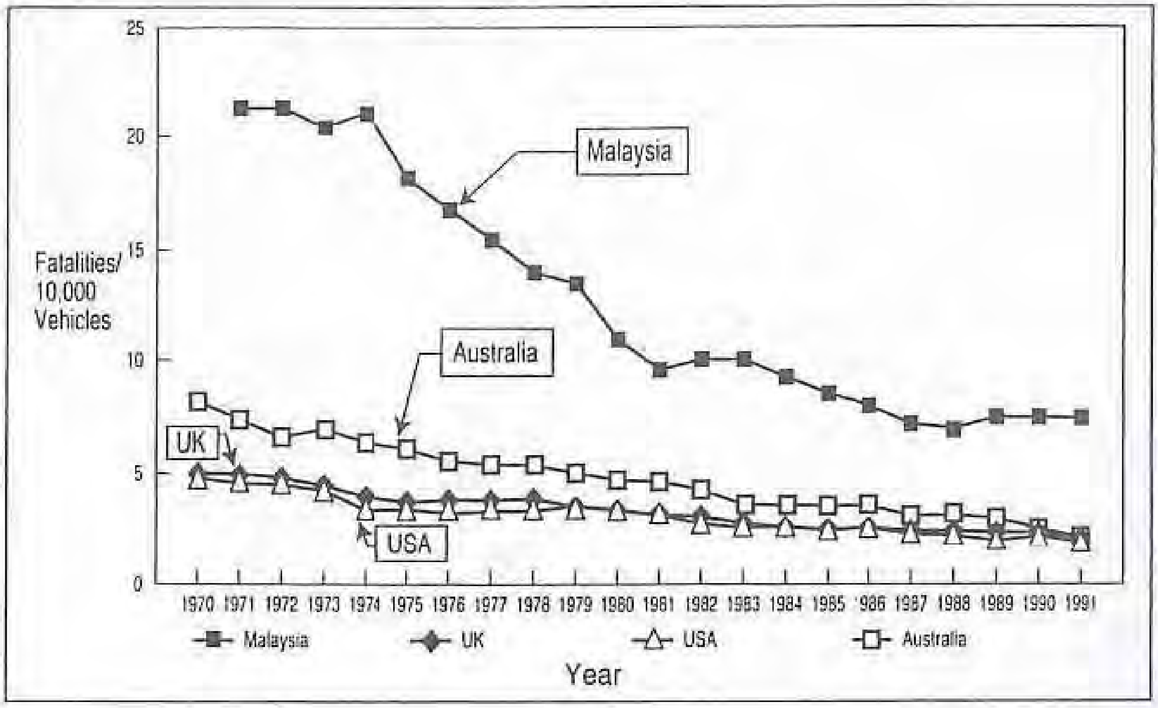
The rate of fatalities due to road accidents is commonly defined as death within 30 days following an accident per 10,000 vehicles. A comparison of Malaysia's figures with those of several developed and developing countries (Transport Research Laboratory, 1995) indicates that Malaysia is ranked about midway between the developed and developing countries (Figure 1). Although the accident fatality rate in Malaysia is well below the figures shown for most developing countries, this is still of concern as the death rate per 10,000 vehicles is well above that for the rest of the developed countries.

**Figure 1 Road Accident Fatality Rates (Deaths per 10,000 Vehicles) for 1989-1993**



A comparison of death rates in Malaysia with those of selected developed countries over a number of years shows that, in recent years, deaths per 10,000 vehicles in Malaysia has been about 7.3 (Figure 2). This is three times the rates in the developed countries, which have been maintained lower than 2.0.

**Figure 2 Deaths per 10,000 Vehicles**




Although there has been a decreasing trend in the overall accident rates in Malaysia, those for the last six years are a cause for concern. This is because fatality rates have been decreasing much more slowly. At a normal growth rate, deaths per 10,000 vehicles are expected to decrease slightly from 7.3 in 1990 to 6.0 in the year 2000. If the higher growth rate is assumed, however, this figure might increase to 8.2 in the year 2000. Unless more drastic measures are taken, the figures achieved by the developed countries will never be reached.

Since the announcement of the safety target a number of safety programmes have been proposed and implemented by various agencies responsible for traffic safety. The programmes vary in terms of emphasis and costs according to priorities and range from a simple low-cost voluntary campaign to a more elaborate safety campaign and legislation, and an expensive engineering countermeasure. The following sections are a critical review of the impact of selected safety initiatives recently carried out by the government.

## Motorcycle Daytime Headlights Campaign and Regulation

There is a widespread belief that motorcycles are more difficult to detect in traffic than any other motorised vehicle. Earlier studies of

individual collisions involving motorcycles (Olson, 1989; Hurt *et al*, 1981; Thomson, 1980; and Radin *et al*, 1995a) indicated that drivers who violate motorcyclists' rights of way often claim not to have seen them before the collision ("looked but failed to see"). As the majority of the accidents occurred while motorcycles had the right of way and particularly while they were travelling straight ahead or turning, it was concluded (Radin, 1995a) that, in the majority of traffic accidents in which they are involved, motorcyclists tend to be the victims of errors made by other road users. With the evidence that improving the conspicuity of motorcycles reduces accidents, a nationwide "Daytime Running Headlight" campaign was proposed and this was launched in July 1992. This was followed by the compulsory use of headlights regulation in September 1992. The percentage of motorcyclists riding with lights switched on increased sharply just after the campaign and stood at about 82% for three months following the campaign.

### *Impact on Conspicuity-Related Motorcycle (MSTOX) Accidents*

The number of MSTOX accidents, defined as all accidents involving motorcycles travelling straight or turning on right of way and colliding with pedestrians or other vehicles, is shown in Table 2. The corresponding plot on cumulative accidents 12 months following the intervention showed that the number of MSTOX accidents deviated slightly only after the fifth month following the campaign. In contrast, a clear separation was observed of all motorcycle accidents immediately after the campaign. The number of all motorcycle accidents increased with time after the campaign which is to be expected in view of the high growth (about 15-20% per annum) of vehicle numbers in Malaysia. As the number of MSTOX accidents remained steady or experienced a slight increase after the fifth month while there was a clear upward trend in all motorcycle accidents, it can be deduced that the campaign and regulation had resulted in a relative reduction of the MSTOX accidents.

For a further analysis of this relative reduction, a chi-square analysis was carried out (Table 3). The MSTOX accidents increased by about 12% while the control data increased by 25%. The computed chi-square value (for one degree of freedom) is 4.03 and therefore it can be concluded that the intervention has reduced significantly ($p<0.05$) the MSTOX accidents in this country.

**Table 2 Two-year Accident Series in Seremban and Shah Alam**

| Before Period (July 1991-June 1992) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Collision Type | Jul '91 | Aug | Sep | Oct | Nov | Dec | Jan '92 | Feb | Mar | Apr | May | June '92 |
| All motorcycle accidents | 112 | 105 | 99 | 110 | 94 | 110 | 140 | 124 | 181 | 131 | 130 | 158 |
| Cumulative accidents | 112 | 217 | 316 | 426 | 520 | 630 | 770 | 894 | 1075 | 1206 | 1336 | 1494 |
| Cumulative mean accidents | 112 | 237 | 362 | 487 | 612 | 737 | 862 | 987 | 1112 | 1237 | 1362 | 1487 |
| MSTOX accidents | 33 | 39 | 40 | 30 | 28 | 44 | 68 | 48 | 79 | 44 | 61 | 73 |
| Cumulative accidents | 33 | 72 | 112 | 142 | 170 | 214 | 282 | 330 | 409 | 453 | 514 | 587 |
| Cumulative mean accidents | 33 | 82 | 131 | 180 | 229 | 278 | 326 | 375 | 424 | 473 | 522 | 571 |
| After Period (July 1992-June 1993) | | | | | | | | | | | | |
| Collision Type | Jul '92 | Aug | Sep | Oct | Nov | Dec | Jan '93 | Feb | Mar | Apr | May | June '93 |
| All motorcycle accidents | 135 | 149 | 122 | 152 | 129 | 165 | 149 | 178 | 169 | 156 | 181 | 192 |
| Cumulative accidents | 1629 | 1778 | 1900 | 2052 | 2181 | 2346 | 2495 | 2673 | 2842 | 2998 | 3179 | 3371 |
| Cumulative mean accidents | 1612 | 1737 | 1862 | 1987 | 2112 | 2237 | 2362 | 2487 | 2612 | 2737 | 2862 | 2987 |
| MSTOX accidents | 53 | 43 | 38 | 49 | 40 | 68 | 43 | 55 | 85 | 51 | 70 | 50 |
| Cumulative accidents | 640 | 683 | 721 | 770 | 810 | 878 | 921 | 976 | 1061 | 1112 | 1182 | 1232 |
| Cumulative mean accidents | 620 | 669 | 718 | 767 | 816 | 865 | 914 | 962 | 1011 | 1060 | 1109 | 1158 |

**Table 3 Before and After Analysis on Conspicuity-Related Accidents**

| Accident type | Before period (Jul 1991-June 1992) | After period (July 1992-June 1993) | Relative increase |
|---|---|---|---|
| MSTOX accidents | 610 | 684 | 12% |
| All motorcycle accidents | 1479 | 1855 | 25% |
| ($\chi2$ = 4.03, df = 1, $p<0.05$) | | | |

### *Multivariate Analysis of MSTOX Accidents*

For long-term impact, a statistical model to describe the relationship between the frequency of MSTOX accidents and a range of explanatory variables was established (Radin *et al*, 1995c). The explanatory variables were the effects of time trend, changes in the recording system, fasting activities during Ramadan and the "Balik Kampong" seasons. The generalised linear modelling technique (McCullagh and Nelder, 1983) and GLIM software (Payne, 1987) was used and the theoretical model is:

MSTOX = exp(α+βWEEK + γRECSYS+δFASTING + εRHL + φ BLKG+e).....(1)

Where α, β, γ, δ, ε and φ are coefficients to be estimated and (e) is the error term representing the residual difference between the actual and predicted model. To express this model in terms which can be used in the GLIM analysis, the ERROR function is defined as Poisson, the LINK function as LOG, and the linear equation becomes:

Log e MSTOX = α+β(WEEK + γ RECSYS + δFASTING + εRHL + φ BLKG + e.....(2)

Based on the criteria of scaled deviance and the ratios of estimates to standard errors, the best fit or parsimonious model (p<0.01) to explain conspicuity-related accidents per week (Radin *et al.*, 1995c) is:

MSTOX = 6.265 [e0.005 WEEK][e0.337 RECSYS][e 0.340 FAST] [e-0.341 RHL].....(3)

Graphically, the observed and modelled weekly MSTOX accidents revealed that the running headlight intervention reduced the MSTOX accidents by about 29% (exp -0.3405). Therefore, it can be concluded that the intervention had been successful in improving conspicuity-related accidents in Malaysia.

### Voluntary Use of Reflective Stripe on Motorcycle Helmets

In October 1992, a campaign to encourage motorcyclists to wear a reflective stripe on helmets was carried out. The aim was to improve night conspicuity of motorcyclists and to reduce rear-end accidents with motorcycles. The campaign comprised:

- distribution of items such as reflective stickers at strategic places such as toll plazas;
- publicity in newspapers; and
- announcements by the Transport Minister on the radio and television.

Field observations on the compliance rate showed that the percentage of motorcyclists with reflective stripes increased markedly (about 50%) in the first month and was at about 80% by the fifth month of the

campaign. This result showed the concern and acceptance of Malaysian motorists to the government campaign.

### *Impact on Rear-End Motorcycle (MSTHB) Accidents in Seremban and Shah Alam*

Table 4 shows the monthly series of rear-end accidents and all accidents involving motorcycles in Seremban and Shah Alam (Radin, 1994b). A total of 4,396 motorcycle accidents were reported between January 1991 and December 1993 of which 580 cases (13.1%) were MSTHB accidents. The total number of motorcycle accidents before the campaign was 1,896 while the total number of accidents after the campaign was 2,496, an increase of about 32%.

**Table 4 Rear-End Accidents and All Accidents involving Motorcycles in Seremban and Shah Alam**

| Before Campaign (Jul 1991-September 1992) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motorcycle | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total | % |
| Rear-end | 20 | 17 | 17 | 20 | 17 | 10 | 18 | 20 | 30 | 16 | 11 | 13 | 15 | 26 | 18 | 268 | 14.1 |
| All motorcycle | 112 | 105 | 99 | 94 | 110 | 141 | 124 | 161 | 130 | 130 | 130 | 156 | 135 | 150 | 122 | 1898 | |
| After campaign (October 1992-December 1993) | | | | | | | | | | | | | | | | | |
| Motorcycle | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total | % |
| Rear-end | 15 | 22 | 20 | 29 | 26 | 17 | 17 | 23 | 36 | 19 | 19 | 19 | 19 | 17 | 16 | 312 | 12.5 |
| All Motorcycle | 115 | 129 | 164 | 151 | 179 | 176 | 155 | 182 | 193 | 172 | 204 | 162 | 188 | 149 | 141 | 2498 | |

Out of 1,896 motorcycle accidents prior to the campaign, a total of 268 (14.1%) involved MSTHB accidents. Although the overall number of MSTHB accidents increased after the campaign (about 16%), the percentage of rear-end accidents was slightly lower (12.5%) after the campaign. This relative reduction is rather indicative and therefore a more detailed analysis was required to ascertain whether this change was statistically significant.

From the cumulative plot of all motorcycle accidents and MSTHB accidents in Seremban and Shah Alam, it could be seen that there was a clear separation between the cumulative number of all motorcycle accidents and the cumulative mean of all accidents after the campaign. The cumulative mean was based on the average growth of accidents over a 15-month period before the intervention. The cumulative plot of the actual MSTHB accidents also showed a small separation from the cumulative mean of rear-end accidents. This separation was rather small compared to the overall motorcycle accidents. Relatively, this could imply that the campaign might have benefited a number of motorcyclists struck from behind.

In order to assess the significance of the relative change indicated in the cumulative plot, a chi-square analysis was carried out (Table 5). The relative reduction in MSTHB accidents was not significant at the 5% level ($p<0.2$) and this implies that the relative reduction was only indicative. The overall increase in rear-end accidents and all motorcycle accidents with time might be due to the natural growth of overall accidents in the pilot areas which may stem from increases in motorisation, population and other exposures such as road length. This was reflected in the overall growth of motorcycle numbers throughout the country and the annual traffic growth of between 2.45 to 14.79% in the pilot areas based on the biannual traffic volume counts (HPU, 1994).

**Table 5 Before and After Analysis of MSTHB Accidents**

| | MSTHB accidents | All motorcycle accidents |
|---|---|---|
| Before campaign (July 1991-September 1992) | 268 | 1898 |
| After campaign (October 1992-December 1993) | 312 | 2498 |
| Growth in accidents | 16.4% | 31.6% |
| ($\chi^2 = 2.2$, df = 1, $p<0.2$) | | |

*Accidents According to Lighting Conditions*

Table 6 shows the pattern of MSTHB accidents according to the lighting conditions before and after the campaign. In this analysis, data from three months were aggregated for each group as the numbers for the monthly intervals were too small. Out of 580 rear-end accidents investigated, about 17% (101 cases) occurred in the dark. The majority of the rear-end accidents occurred in the day.

**Table 6 MSTHB According to Lighting Conditions**

| Before Campaign (July 1991-September 1992) | | | | | |
|---|---|---|---|---|---|
| Lighting conditions | Jul-Sep | Oct-Dec | Jan-Mar | Apr-Jun | Jul-Sep |
| Daytime | 46 | 41 | 58 | 34 | 51 |
| Nighttime | 8 | 6 | 9 | 6 | 8 |
| **After Campaign (October 1992-December 1993)** | | | | | |
| Lighting conditions | Oct-Dec | Jan-Mar | Apr-Jun | Jul-Sep | Oct-Dec |
| Daytime | 47 | 56 | 56 | 46 | 43 |
| Nighttime | 10 | 16 | 20 | 11 | 7 |

In order to se( .ether there was a significant increase in night MSTHB accidents after the campaign, a $\chi^2$ analysis was carried out. Table 7 shows that both rear-end and all motorcycle accidents increased after the intervention. The increase in night-time rear-end accidents was about 73% while the increase in all night-time motorcycle accidents was about 31%. However, the increase was not significant at the 5% level ($p<0.2$), implying that the campaign neither reduced nor increased MSTHB accidents. Such an increase might be purely due to the natural growth of traffic, reflected by the control data, low exposure of night MSTHB accidents and the manner in which the campaign was implemented.

**Table 7 Before and After Analysis of Night-time MSTHB Accidents**

| | Night-time MSTHB Accidents | All Night-time Motorcycle Accidents |
|---|---|---|
| Before Campaign (Jan 1991-September 1991) | 37 | 385 |
| After Campaign (Oct 1992-December 1993) | 64 | 505 |
| Growth in Accidents | 73% | 31% |

($\chi^2 = 2.42$, df = 1, $p<0.2$)

## The First World-Exclusive Motorcycle Lanes: Federal Highway F02, Shah Alam

The notion of segregating motorcycles from other traffic by the use of a motorcycle lane is not new to Malaysia. In the early 1970s, the world's first motorcycle lane was constructed along the F02, under a World Bank project; this remains a first in the history of motorcycle safety. Unfortunately, no study has so far been conducted to analyse the safety and economic benefits of the scheme. In early 1992, however, an extension of the track was carried out under the improvement programme of the existing two-lane expressway connecting the Subang International Airport and Klang. In late November 1993, major sections of the lane were completed ahead of schedule and were opened for public use.

### *Impact of Exclusive Motorcycle Lane on All Motorcycle Accidents*

From the cumulative plot of motorcycle accidents along the route and all accidents in Shah Alam (Radin *et al*, 1995b), it could be seen that the number of motorcycle accidents dropped markedly immediately following the opening of the motorcycle lane. There was a clear downward separation of cumulative numbers of motorcycle accidents with respect to the predicted cumulative mean of accidents. In contrast to the reduction of motorcycle accidents, the number of all accidents in the control area remained steady at an average rate of 235 accidents per month. The number of accidents in the control area in the before period was 2118 while the after period was 2202.

### *Log-Linear Model for Motorcycle Accidents Along the Tracks*

For more detailed analysis on longer sets of data, a statistical model to describe motorcycle accidents along the tracks was established. The theoretical model (Radin, 1996) that contains all terms is:

MCACC = k Qα Exp (βFAST + γRECSYS + δRHL + φBLKG + ϕSTRIP + ξLANE + τCONS + e) ..... (4)

where MCACC is the monthly series of motorcycle accidents along F02, and the independent variables are summarised in Table 8.

**Table 8 Explanatory Variables for Modelling Motorcycle Accidents along F02**

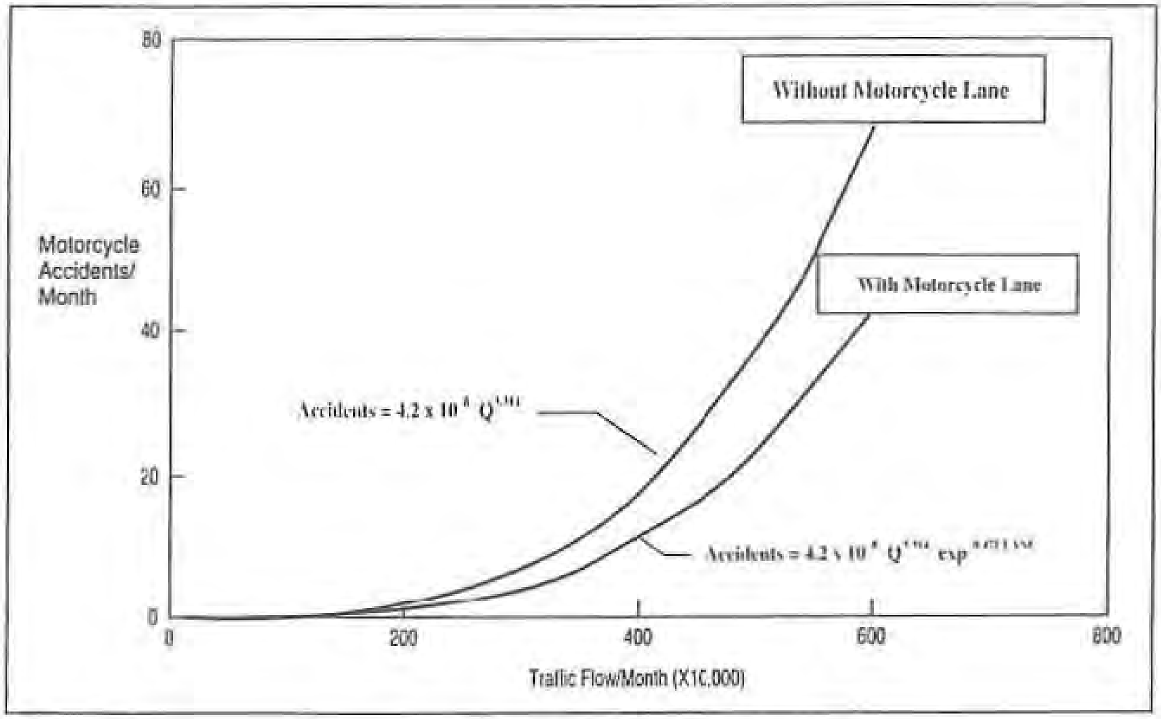
| Explanatory Variable | Description | Coding System in GLIM |
|---|---|---|
| Q | Total traffic flow per month | Flow (x 10,000)/month |
| FAST | Effect of the fasting month in Ramadan | (1) Not fasting<br>(2) Fasting month |
| RECSYS | Effect of change in accident recording system | (1) Old system (manual)<br>(2) POL27 and MAAP |
| RHL | Effect of the running headlights intervention | (1) Before RHL<br>(2) After RHL |
| BLKG | Influence of Balik Kampong seasons (Chinese New Year, Hari Raya, Deepavali, Christmas, school holidays | (1) Not BLKG<br>(2) BLKG seasons |
| STRIP | Effect of the reflective stripe on helmet campaign (Oct 1992) | (1) Before campaign<br>(2) After campaign |
| LANE | Effect of the motorcycle lane opening (18 Dec 1993) | (1) Before opening<br>(2) After opening |
| CONS | Effect of construction stage | (1) Not in construction<br>(2) During construction |

The parameters α, β, γ, δ, ε, φ, ϕ, ξ and τ are coefficients to be estimated while (e) is the error term expressed as residual deviance. Using the Poisson errors in GLIM, 5% significant level of the "t" values (Radin *et al*, 1995c) and the change in corrected scale deviance due to overdispersion (Aitkin *et al*, 1989), the best model to describe link motorcycle accidents along F02 is:

Link motorcycle accidents = 4.2 x 10-8 Q3.314 exp-0.471 LANE.....(5)

All other terms were not significant at the 5% level. This model suggests that motorcycle accidents are directly proportional to the cubic power of traffic flow (Q3.314) and reduced by almost 39% (1-e-471) with the opening of the motorcycle lane. Graphically, the impact of the motorcycle lane is shown in Figure 3.

Figure 3: Relationship Between Motorcycle Accidents and Traffic Flow




### *Impact on Accident Severity and Casualty Injury along the Track*

The breakdown of accidents according to their severity before and after the opening of the motorcycle lane is shown in Table 9. Note that the fatal accidents plummeted significantly ($p<0.05$) from six to only one

**Table 9 Before and After Analysis of Accident Severity and Casualty Injury**

| Accident severity<br>Casualty injury | Before<br>(Dec 1992-Nov 1993) | After<br>(Dec 1993-Nov 1994) | $\chi^2$ | Significance level |
|---|---|---|---|---|
| Fatal accidents | 6 | 1 | 4.04 | p<0.05 |
| Fatalities | 6 | 1 | 5.05 | p<0.025 |
| Serious accidents | 4 | 9 | 1.52 | p<0.25 |
| Hospitalised | 4 | 9 | 0.86 | p>0.05 |
| Slight | 102 | 96 | 1.03 | p>0.05 |
| Minor injury | 120 | 131 | 1.68 | p>0.05 |
| Damage | 43 | 6 | 31.0 | p 0.01 |
| Total accidents | 155 | 112 | 7.2 | p<0.01 |
| Total casualties | 130 | 141 | 1.94 | p>0.05 |
| Control accidents | 2818 | 3070 | | |
| Control casualties | 1007 | 1306 | | |

after the intervention. Consequently, the fatalities dropp( ignificantly ($p<0.025$) from six to only one death in the after period. A detailed investigation of this fatality found that the victim was killed in a single-motorcycle accident. No fatality has so far been observed for the multiple motorcycle accidents in the after period.

The analysis of the serious accidents on the other hand revealed a contrasting picture. The serious accidents and their corresponding hospitalised cases increased from four in the before period to nine in the after period. Although the overall slight accidents reduced from 102 to 96 cases, their corresponding injuries increased from 120 to 131 cases. These changes were not however significant at the 5% level ($p \gg 0.05$).

### *Analysis of Relative Vulnerability of Motorcyclists*

To investigate the above observations further, an analysis of relative vulnerability of motorcycles (Table 10) before and after the opening of the lane was carried out. This index was computed from the ratio of casualties to accidents and reflected the probability of injuries sustained by motorcyclists in an accident.

**Table 10 Relative Vulnerability of Motorcyclists Before and After Intervention**

| Type of accidents | Before (Dec 1992-Nov 1993) | After (Dec 1993-Nov 1994) |
|---|---|---|
| Single motorcycle accidents | 41 | 40 |
| Single motorcycle casualties | 40 | 38 |
| Relative vulnerability (odds ratio) | 0.98 | 0.95 |
| Significance level | | $\chi^2 = 10.01$, $p \gg 0.05$ |
| Multiple accidents with motorcycles | 114 | 72 |
| Casualties involving motorcycles | 90 | 103 |
| Relative vulnerability (odds ratio) | 0.79 | 1.43 |
| Significance level | | ($\chi^2 = 8.19$, $p<0.005$ |

From the analysis, it can be seen that the relative vulnerability for single motorcycle accidents remained unchanged ($p \gg 0.05$) in the after period. An opposite picture however was observed in the multiple accidents. The odds ratio of injury almost doubled from 0.79 in the before period to 1.43. This change is highly significant ($p<0.005$) at the 0.5% level.

Detailed investigation of the before data also revealed that the majority of the multiple accidents (Table 11) involved motorcycles and other vehicles. This collision type, however, has been transformed into the motorcycle-motorcycle accidents in the after period. This might account for the high number of casualties in the after period.

**Table 11 Bef[illegible] and After Analysis of Numbers of Vehicles Involved in Motorcycle Accidents**

| Accident severity | Before (Dec 1992- Nov 1993) | After (Dec 1993- Nov 1994) | $\chi^2$ | Significance level |
|---|---|---|---|---|
| Single motorcycle accidents | 41 (26.5%) | 40 (35.7%) | 0.24 | p<0.7 |
| Two-vehicle accidents | 107 (69.0%) | 71* (63.4%) | 10.39 | p<0.005 |
| Three and more vehicle accidents | 7 (4.5%) | 1 (0.8%) | 5.03 | p<0.025 |
| Control | 2818 | 3070 | | |

*Motorcycle-motorcycle accidents

### *Effects on Collision Types*

The breakdown of collision types (Table 12) shows that the majority of accidents (approximately 49%) are the side-swipe type. This is followed by off-road (approximately 30%), rear-end (approximately 15%) and other types of accidents (about 10%). The latter includes accidents with pedestrians (1%), side collisions at entry and exit lanes (2%), accidents with animals and objects on road (6%) and others (1%).

**Table 12 Breakdown of Collision Types Before and After Opening of Motorcycle Lanes**

| Collision type | Before (Dec 1992- Nov 1993) | After (Dec 1993- Nov 1994) | $\chi^2$ | Significance level |
|---|---|---|---|---|
| Side-swipe | 76 (49.0%) | 55*(49.0%) | 5.29 | p<0.025 |
| Rear-end | 32 (20.6%) | 16*(14.3%) | 6.75 | p<0.01 |
| Off-road | 37 (23.9%) | 34(30.4%) | 0.51 | p<0.5 |
| Others | 10 (6.5%) | 7(6.7%) | 0.82 | p<0.5 |
| Total | 155 | 112 | 10.7 | p<0.005 |
| Control | 2818 | 3070 | | |

*motorcycle - motorcycle accidents

The analysis also indicated that the rear-end and side-swipe collisions dropped significantly (p<0.01) following the intervention. The reductions were significant at 1% (p<0.01) and 0.5% (p<0.005) respectively. The rates of off-road accidents and other types of accidents however remain unchanged as they were not significant at the 5% level.

however remain unchanged as they were not significa t the 5% level.

## Conclusions and Recommendations

The following conclusions can be drawn.

### *Traffic Exposure*

The change in traffic exposure appeared to be an important variable in interpreting accident trends in Malaysia. This influence is highly significant and could be due to rapid growth in population, vehicles and kilometerage in Malaysia. The inclusion of this variable offers a comprehensive interpretation of the actual impact of safety intervention as the after period data are sometimes higher than those of the before period. This is clearly demonstrated by the graphical presentation of MSTOX accidents, and the relationship between motorcycle accidents and traffic flow along the Federal Highway F02. The analysis revealed that there has been a significant drop ($p<0.05$) in the conspicuity-related motorcycle accidents following the interventions. The overall drop in these accidents was 29% which supports the notion that running headlights improves conspicuity and reduces conspicuity-related motorcycle accidents. The analysis of the impact of the motorcycle lane also revealed that traffic segregation by means of exclusive motorcycle lanes proved to be one of the best ways to achieve the desired safety objective, particularly along routes with high numbers of motorcycles. This is because the number of motorcycle accidents was dramatically reduced following the intervention. The overall reduction 13 months following the opening of the lane was found to be about 39% and highly significant at the 5% ($p<0.05$) level.

### *Value of Safety Evaluation*

The value of detailed evaluation of safety initiatives has also been demonstrated. The use of appropriate criteria in measuring the success instead of simple accident numbers is extremely important as many factors can be attributed to the change in the accident patterns. The use of an appropriate evaluation technique, such as the multivariate statistical modelling approach, is also important as it gives more insight into the interpretation of accident patterns. Besides furnishing a detailed evaluation of the safety initiatives, this provides a strong basis and guidelines for future countermeasures. Thus, detailed evaluation must be included as part of the framework and special allocation should be given to evaluate all safety interventions.

### *Public Acceptability*

One of the important findings from the study was the public acceptance of government safety campaigns. From the field observations, approximately 82% of the riders complied with the campaign three months following the advertisement and approximately 80% with the reflective stripe. This compliance rate is

very encouraging and implies that, as a result of the conducive political, economic and social environments, Malaysian riders tend to welcome safety propaganda. Thus, road safety campaigns can generally be considered a promising method of promoting traffic safety in Malaysia. The public needs, however, to be consistently informed about the success and positive benefits of the campaign in order for this high level of compliance to be maintained.

### The Next Steps?

In principle, any measure to improve the safety of motorcyclists must be encouraged. Although systematic research and planned measures are strongly recommended before safety initiatives are carried out, any initiative, be it small or large, should be given due attention. The above study, for example, showed that the running headlights intervention was implemented according to a systematic diagnosis approach. The campaign to encourage use of a reflective stripe and the construction of a motorcycle lane, on the other hand, resulted from government and private sector initiatives and good intentions. It may be noticed, however, that a higher success rate was observed when the countermeasures were relevant to the accident problems and could be based on strong theoretical foundations.

In a study on injury risk (Radin, 1995a), it has been shown that motorcyclists rank highest for both number and severity of accidents among the road users in Malaysia. Approximately 68% of all injuries involve motorcyclists, and their overall relative risk is approximately 20 times higher compared with the that of car users. This injury index is comparable with Chin (1991) and Johnston (1992) who found that motorcycle riders are 18 and 20 times as likely to be killed or seriously injured compared to car drivers in the UK and Australia, respectively. In view of the high population of motorcycles in Malaysia (about 60%) and their high injury risk, serious attention to this target group is therefore justified. Solving the problem of motorcyclists means solving the key problem of accidents in Malaysia.

#### *Future Strategies for Injury Reduction in Malaysia*

There are at least two main strategies for reducing disabilities from injuries and accidents:

- accident reduction and prevention; and
- injury reduction.

Accident reduction and prevention involves the application of the "Three Es": education, engineering and enforcement. In addition, the application of safety principles in the provision, improvement and maintenance of roads, more commonly known as the "road safety audits", can be used so that potential safety hazards can be evaluated

before a new road is opened to traffic.

Injury reduction involves the application of appropriate safety policies, vehicle and road engineering approaches, and medical and trauma management. A number of studies have indicated that this approach is capable of reducing further casualties up to nearly 30%. These may be achieved by five distinct strategies: exposure control, crash prevention, behaviour modification, injury control and post-injury management (Trinca *et al*, 1988).

Injury reduction or control strategies attempt to reduce the likelihood and severity of injury-producing impacts during the accidents (Pedder, 1992). They are based on a recognition that deaths and injury severity can be reduced if the actual conditions operating during the crash plane are modified. They are also based on knowledge that if the forces acting on a vehicle occupant can be reduced by appropriate "packaging", substantial benefits will accrue (Trinca *et al*, 1988).

### *Occupant Protection Measures*

There are a number of measures for protecting occupants from injury in the event of accident. Among the most common are safety belts, child restraints and protective clothing such as safety helmets, safety jackets and boots for motorcyclists.

Many studies in several countries have been carried out to measure the effectiveness of safety helmets. Cams and Holbourn (1943) showed that of acute head injury cases, 32% occurred to people wearing crash helmets compared to 68% to people who did not. Jamieson and Kelly (1973) in Australia studied the injury patterns of motorcycle accident cases and found a significant reduction in head injuries (between 51.5% and 67.5%) for victims wearing helmets. A California study (Kraus *et al*, 1970) showed a significant reduction of serious head injury cases for helmet users (15%) as compared to non-users (23%). Similar benefits were also reported in Malaysia, where the compulsory helmet law has resulted in about 30% reduction in motorcycle fatalities (Supramaniam *et al*, 1984). These studies support the notion of the benefits of motorcycle safety helmets in reducing injuries due to accidents.

Safety belts are by far one of the most cost-effective forms of adult restraint. A simple lap belt is a minimal type of restraint as it provides some protection by preventing the occupant being flung around inside the vehicle, injuring other occupants, or from being thrown out of vehicles. The three-point fixing lap and diagonal belt, which is now frequently featured in modern vehicles, has proved to be an effective measure as injury statistics testify. In many countries, wearing safety belts has been made mandatory for people in front seats of vehicles. A good number of studies such as Loeb (1993), Monash Accident Research Centre (1992) and McLeah *et al* (1979) have reported on the

benefits of this measure. The results of these studies provide strong indication that seat belt laws generally have an impact on reducing injury rates. Unrestrained occupants were shown to be three to four times more likely to be hospitalised or killed in frontal crashes than those restrained (McLean *et al*, 1979). The more serious injuries to cervical spine in Canada (Bourbeau, 1992) were more prevalent among unbelted occupants compared with the belted ones. A study in Finland (Valtonen, 1991) also showed an annual reduction of about 23% in the number of fatalities two years following the compulsory belt law for rear passengers in 1987. A study in Victoria (Joubert, 1981) also supported the notion that compulsory legislation produces a remarkable saving of lives and reduction of injuries by about 30% and 45% respectively.

The benefits of heavy fabric or leather protective clothing have been clearly shown in many studies. Protective clothing, specifically leather, reduces the likelihood of abrasion and lacerations as well as affording some protection against contamination of more serious wounds (Pedder, 1992). Engstrom (1979) showed that out of 39 people equipped with protective clothing, none had injuries above the AIS>3. Leather trousers (Aldman *et al*, 1981) protect the lower extremities significantly ($p<0.05$), while motorcycle gloves reduce hand injuries significantly at the 1% level ($p<0.01$). Unfortunately, use of this clothing is not feasible in a hot and humid country like Malaysia. In addition, it is not designed for the local environment where conspicuity is one of the major problems. In view of these difficulties, prototype protective clothing for motorcyclists which can afford protection as well as improving detectability is under research by Universiti Pertanian Malaysia.

### *Vehicle Design and Crash Compatibility*

The other type of protective system is the one that offers passive protection, such as air bags, and interior packaging of vehicles such as energy-absorbing steering wheels, better instrument panel design and improved padding and structures. These features are normally incorporated in vehicle design and may be called vehicle-oriented protection systems. In recent years, these features have been made available to many modern vehicles as part of standard features provided by manufacturers.

The application of crash protective principles through both legislation and education is an important strategy for reducing the severity of injury to road users. Besides improving engine performance, vehicles should be designed so as to produce optimum protection to their occupants. This can be achieved by employing the knowledge on crashworthiness, appropriate technical specifications and standards which promote safety and improvement in crash compatibility between different classes of vehicles. A good example of the last approach is the use of invertube

front under-run guards (Riley *et al*, 1991) for heavy vehicles which improves crash compatibility between trucks and smaller vehicles. Occupants in smaller cars wearing seat belts should be able to survive impacts with lorries fitted with this tube at closing speeds up to 64 km/h.

### Road Environment

Crash energy management principles can also be applied to road furniture design. In typical off-road accidents, the severity of the subsequent collision is increased by the size and rigidity of the object struck. This phenomenon is supported by Hassan (1994) who pointed out that collisions with lamp posts and trees accounted for about 59% of moderate to fatal single-vehicle accidents. The odds ratios of experiencing moderate to fatal injuries compared with minor to less injuries are higher in collisions with trees (2.28) and poles (1.98) compared with wide objects. The odds of experiencing moderate to fatal injuries compared to minor or less injuries were found to be higher in collisions with metal objects which are mainly poles (3.06) and wooden (2.44) compared to objects made from stone materials.

Many low-cost solutions are now available to alleviate these problems. The use of crash barriers to prevent vehicles leaving the highways and striking hostile objects, collapsible poles instead of solid poles, and appropriate landscaping, e.g. trees planted away from the crash path yet providing the required canopy, are among the measures that can be used to overcome these problems. Safer engineering practices should be promoted and careful planning at the design stage can avoid most of the problems.

### Post-Injury Management

As traffic accidents cannot be prevented completely, efficient treatment and rehabilitation services are needed to deal with those injured. Studies have shown (Trinca *et al*, 1991) that road deaths typically occur in one of three distinguishable time periods:

- within minutes after a crash: about 50% of those who die do so within this period and little can be done through medical efforts;
- within one to two hours of injury: about 35% of deaths occur in this period and increased survival rates are likely to result from early and appropriate medical efforts;
- during 30 days following hospital admission: about 15% of deaths occur during this late stage and improved medical care is unlikely to reduce this proportion.

Survival and the extent of recovery will therefore depend on the initial care given at the roadside rather than at later stages of acute care. Thus, correct and efficient management systems are vital for the survival of the critically injured victims. The establishment of paramedic teams, trauma centres

and after-c services such as follow-up rehabilitation facilities are some of the measures to reduce injuries and disabilities from accidents.

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# THE HISTORY OF THE FREIGHT TRANSPORT ASSOCIATION

## *Presented at a Symposium of the Roads and Road Transport History Conference, Coventry, 18 October 1997*


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### Introduction

The first difficulty is knowing where to begin.

There are those who would argue that there is an unbroken line through from the 16th century and the creation of the Fraternity of St Katherine, the forerunner of the Worshipful Company of Carmen, to the modern transport association. Certainly the history of those earliest days of the organised carters is well documented in, for example, Eric Bennett's history of the livery company[1]. The reasons which persuaded the carters to band together are probably the same as those which persuade the lorry operator to join and support the Freight Transport Association (FTA) or the Road Haulage Association (RHA) today.

Fascinating as that history might be, however, we will be on firmer ground if our story commences some 300 years later, in the final quarter of the 19th century. The FTA of today reflects the two main influences in its history:

- the early domination of the railway companies and the resulting need for an effective voice for the rail customer;
- the development of the internal combustion engine.

### The User's Interests

While this symposium relates primarily to roads, the story of the FTA cannot be told without paying proper regard to its user protection origins and, indeed, the importance of that aspect of its work over the intervening years right up to today.

If a single date had to be chosen as marking the birth of the Association it would be 26 July 1889, which indeed was used when the FTA marked its centenary eight years ago. It is, however, legitimate to go back a little further to 1881. In that year, in response to the growing domination of the railways, a Railway Rates Committee of the London Sugar Trades formed an association as "their only means of defence against the power represented by the united railway companies"[2].

The following year that informal body was properly constituted as the Railway and Canal Traders Association. Bearing witness to the seriousness of the problems facing the rail customers, three of the 44 members of the first national council were Mr Blackwell of Crosse &